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Forbes

NUCLEAR FOLLIES

The failure of the U.S. nuclear power program ranks as the largest managerial disaster in business history, a disaster on a monumental scale. The utility industry has already invested $125 billion in nuclear power, with an additional $140 billion to come before the decade is out, and only the blind, or the biased, can now think that most of the money has been well spent. It is a defeat for the U.S. consumer and for the competitiveness of U.S. industry, for the utilities that undertook the program and for the private enterprise system that made it possible. Without even recognizing the risks, the U.S. electric power industry undertook a commitment bigger than the space program ($100 bil[illegible] War ($111 billion) . . .

(continued on page 82)

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Forbes

February 11, 1985
Volume 135
Number 3

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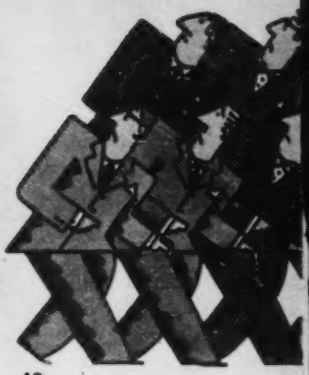

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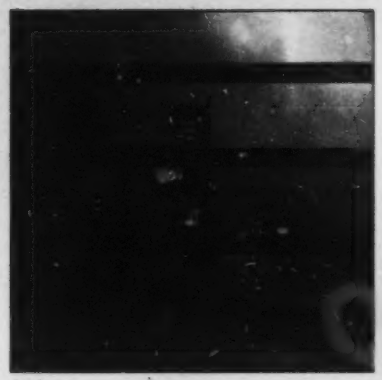

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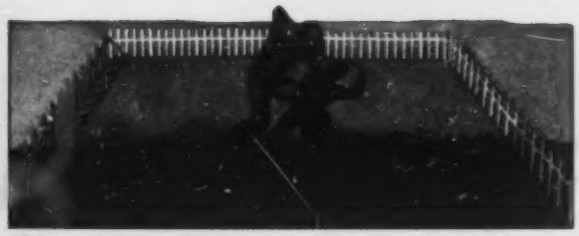

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February 11, 1985 Volume 135 Number 3 Forbes (ISSN 0015 6914) is published biweekly, except weekly during two weeks in April and two weeks in October, by Forbes Inc., 60 Fifth Ave., New York, N.Y. 10011. Second-class postage paid at New York, N.Y. and at additional mailing offices. Subscription $42 a year, U.S.A. Postmaster: Send address changes to Forbes, 60 Fifth Ave., New York, N.Y. 10011.

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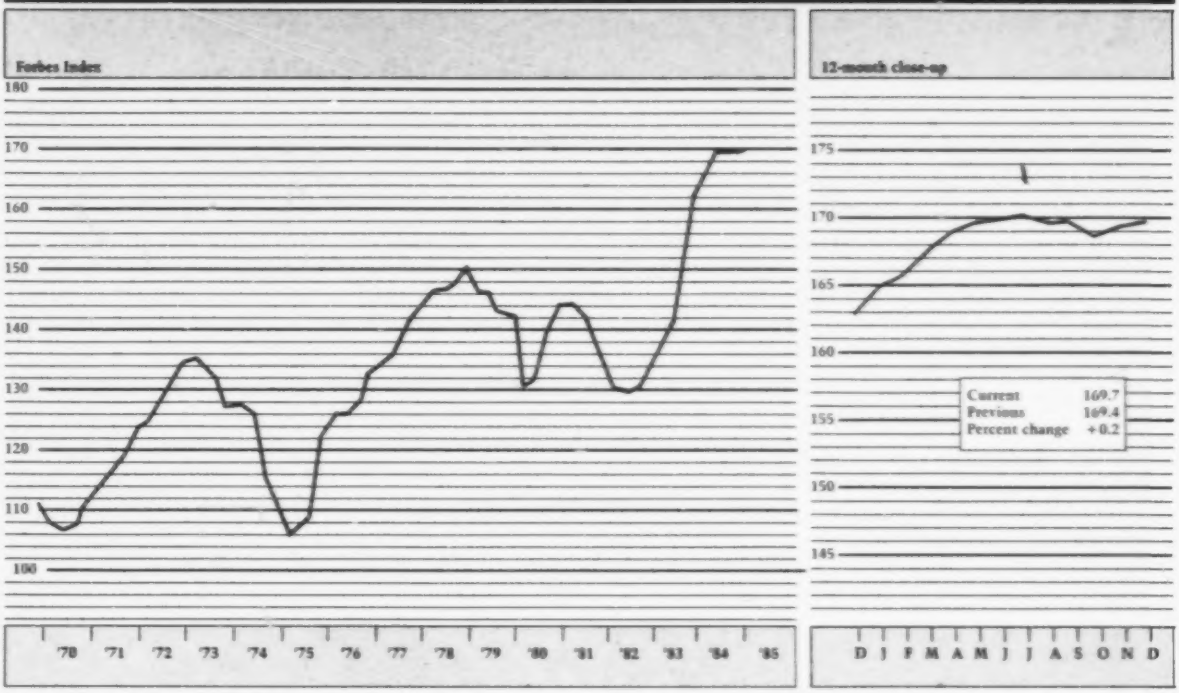
The Forbes Index

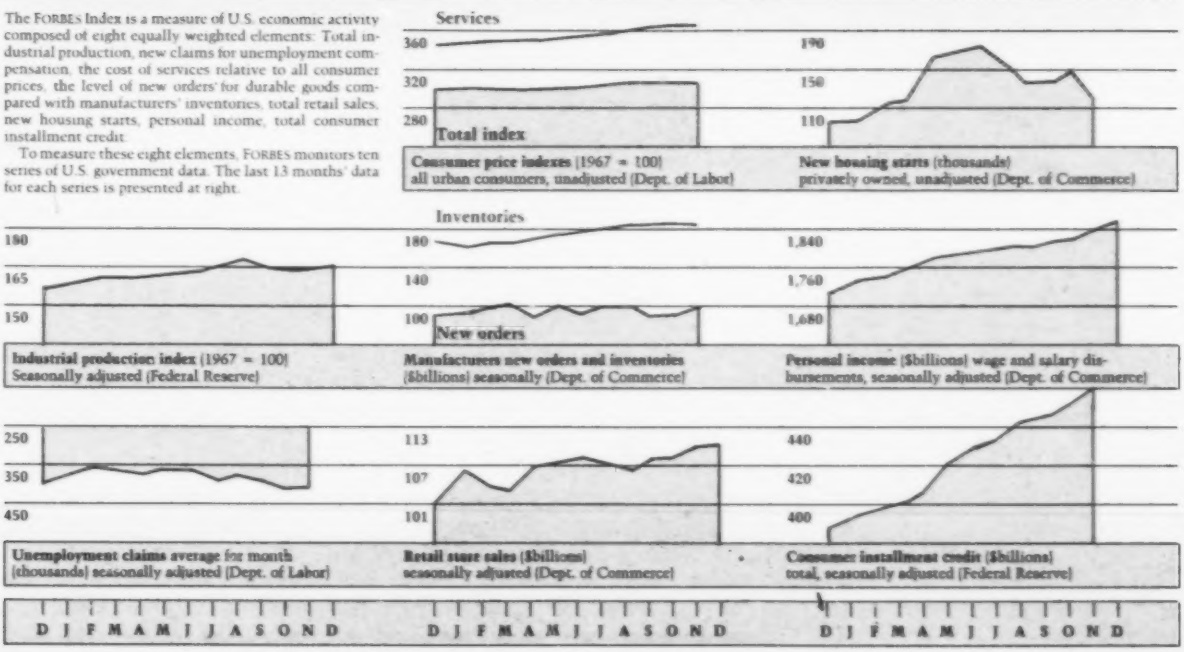


Cracks in the ice. With a 0.2% rise in the latest reporting period, the Forbes Index once again signaled that the cool-down in the economy may be moderating. Industrial production managed a 0.6% increase over the previous month. Consumer installment credit rose 1.8% over the previous month. The credit figure, however, now stands some 20.6% higher than it did one year previously, while the latest figures on personal income show a 1% month-to-month rise and only a 7.9% increase over the level of 12 months earlier. After tightening their belts during the last recession, consumers are once again willing to take on more debt. However, consumers' indebtedness cannot continue to rise faster than their incomes indefinitely, so the upward trek of the Forbes Index could soon end.

The Forbes Index Components

The FORBES Index is a measure of U.S. economic activity composed of eight equally weighted elements: Total industrial production, new claims for unemployment compensation, the cost of services relative to all consumer prices, the level of new orders for durable goods compared with manufacturers' inventories, total retail sales, new housing starts, personal income, total consumer installment credit.

To measure these eight elements, FORBES monitors ten series of U.S. government data. The last 13 months' data for each series is presented at right.



Nuclear Follies

By James Cook

continued from cover

. . . and, in little more than a decade, transformed what elsewhere in the world is a low-cost, reliable, environmentally impeccable form of energy into a power source that is not only high in cost and unreliable, but perhaps not even safe.

The scale of the U.S. nuclear power program's collapse is appalling: 75 plants canceled since 1978, including 28 already under construction, with another half-dozen or so cancelations in prospect. Even in its death throes, the U.S. nuclear program looks ambitious: 16 new stations put into commercial operation since 1979, another 3 this past year, and 40 more units by the end of the decade. By that time nuclear power will account for something like 20% of the U.S.' total generating capacity, up from 14% today. Altogether, these stations will be producing 129,725 megawatts, more than the nuclear capacity of France, West Germany, Japan and the Soviet Union put together. But that's it. Once these plants are completed, the U.S. nuclear power program is at an end.

Elsewhere in the world, some 148 nuclear power plants are under construction, 9 more are on order and 157 are in the planning stage. By 1990 the Japanese should be getting close to 20% of their electricity production from nuclear power, the Taiwanese 30%, the Belgians 40%, the French 55%. That's low-cost energy, all of it, and, according to one study, 30% to 50% lower in cost than coal. The newest French nuclear plant, at Cruas in the south of the country, produces power for under 4 cents a kilowatt-hour, and that's cheap by almost any standard.

In the U.S., however, nuclear power makes less and less economic sense. Production costs of existing coal and nuclear plants run neck and neck, but as the new nuclear plants go into service, coal should gain ground decisively. In upstate New York, New York State Electric & Gas' newest coal-fired station at Somerset began producing power last August at a cost of 7.5 cents per kwh. A hundred miles away, Niagara Mohawk's $5.1 billion Nine Mile Point nuclear plant will produce power two years from now for 18 cents per kwh.

At such levels, nuclear power can't compete with oil, much less with coal. That's why, for the U.S., nuclear power is dead—dead in the near term as a hedge against rising oil prices and dead in the long run as a source of future energy. Nobody really disputes that. Not the Nuclear Regulatory Commission (NRC) or the Office of Technology Assessment. Not even the Atomic Industrial Forum (AIF), the trade organization that represents the nuclear power industry. And certainly not the 200 or so executives who head the U.S.' investor-owned electric companies. Nuclear power is an option nobody in his right mind would now seriously consider. "The costs and risks of nuclear development," an Edison Electric Institute study concluded last month, "have become unacceptably high."

What destroyed the nuclear option in the U.S.? How could U.S. nuclear power costs run so outrageously out of control? And why didn't the NRC or the state regulators, never mind the utility managements, do something about them? Most important of all, why did the U.S. fail where the French, Germans and Japanese succeeded? The answers to such questions are important, and

they suggest a good deal about where the U.S. is going to go—or perhaps ought to go—in the future. Without an understanding of what caused the nuclear debacle, the U.S. will lack any clear sense of what it must do not only to restore nuclear energy as a viable energy option but also to assure that history does not repeat itself.

1 The incredible price

It wasn't technology that doomed nuclear power in the U.S. As experience everywhere demonstrates, the technology is as sound and productive as its promoters always have claimed it would be.

Nor was it the dedicated and imaginative obstructionist tactics of the antinuclear forces, effective though they were. The opponents of nuclear power have hampered and harassed it, inflated its costs and stretched out construction times to unconscionable lengths, but they could not, unassisted by events, have prevailed.

The truth is that nuclear power was killed, not by its enemies, but by its friends:

- The federal government and the Nuclear Regulatory Commission, which not only botched the day-to-day management of the program but also failed to consider the economic cost of the regulations it imposed.
- The equipment manufacturers, who maintained that nuclear power was just another way of boiling water.
- The contractors and subcontractors, the designers, engineers and construction managers who, insulated by their own cost-plus contracts, had little incentive to question the cost-effectiveness of the NRC's dictates.
- The utility executives, who believed that no matter what happened to cost and construction schedules, the rate commissions would somehow provide the revenues to bail them out.
- And the state regulatory commissions themselves, whose grossly inadequate oversight of the schemes, ambitions and monstrous expenditures for nuclear projects made it easier for all of the above to betray consumers and investors alike.

These collective failures are reflected in the accompanying table *(see p. 85)*. It lists 35 nuclear power projects that had not yet gone into commercial operation at the beginning of 1984. These new plants cost six to eight times more than originally projected, three to four times more on average than nuclear plants already operating. As a result, more than half the plants on the list are no longer competitive with coal nor, some of them, even with oil.

These plants, some conceived as early as the late Sixties, were subjected to all the problems that afflicted the industry over the past decade. All suffered the delays and cost overruns that doubled the average construction time from 6 to 12 years. Yet for all their common technical, social and political environment, the costs of these plants differ widely, ranging from a commendable $932 a kilowatt for Duke Power's McGuire 2 station to a grotesque $5,192 a kilowatt for Long Island Lighting's Shoreham plant.

The pressures of regulation and antinuclear interveners created more problems for some plants than for others, but they are not enough to explain so wide a range of differences. Labor costs are not appreciably lower in Chicago than they are in New York. Opposition to nuclear power is no more intense on Long Island than it is in northern California.

The disparities in cost are so great as to make a prima facie case for mismanagement in the first degree. At least a dozen projects still going forward—more than one in four—are problem plants by any measure, suffering from quality, construction and design problems as well as cost overruns.

The mismanagement extends beyond design and construction to financial management. At least half a dozen utilities have abandoned plants already well on their way to completion—Marble Hill and Midland among them—because they simply did not have the financial resources to complete them. Other projects still alive—Shoreham, Seabrook and second units everywhere—are similarly imperiled. The financial pressures have been so extreme that at least six major utilities—including Lilco, Public Service of New Hampshire, Consumers Power in Michigan, Public Service of Indiana—are in serious danger of going into bankruptcy.

But for legal reasons—never mind pride—managements can admit no wrong. Any admission of mismanagement is tantamount to an admission of "imprudence," and some state regulatory commissions, growing increasingly worried about the effect these plants will have on the cost of electricity, have begun disallowing at least part of their costs on just such ground. The staff of the New York State Public Service Commission has proposed disallowing close to $1.5 billion in Lilco's nuclear expenditures as imprudent. Such a sum, Lilco Chairman William Catacosinos readily concedes, would be enough to bankrupt the company.

Bankruptcy would not put the companies out of business. They are certain to survive as operating, if not corporate, entities. But a price will have to be paid—indeed, already is being paid—in the form of higher rates.

The failure of the U.S. nuclear power program is changing the economic geography of the U.S., encouraging business to exchange high-cost power for low, weakening areas in the East, the Midwest and the Northwest, strengthening the already resurgent South. Lukens, Inc. in Coatesville, Pa. already has tried (unsuccessfully, thus far) to escape Philadelphia Electric and its high-cost Limerick power in favor of Pennsylvania Power & Light, just as U.S. Steel's Gary Works tried unsuccessfully to shift from Illinois Power to Commonwealth Edison. To avoid the large rate increases in prospect with the completion of Middle South Utilities' Grand Gulf nuclear plant, the governor of Arkansas, anxious to keep his state competitive, has threatened to take Arkansas Power & Light out of the Middle South system altogether.

What is so heartbreaking is that if things had been different—if the times were not what they

The truth is that nuclear power was killed, not by its enemies, but by its friends.

were, if the regulators had been more responsible, if the utility managements and nuclear contractors had been more competent, and, of course, if the antinuclear obstructionists had not been so imaginative and successful—none of it need have happened. But it did. And the U.S. will pay the price for decades to come.

2 The setup

The electric utilities burst into the nuclear age with an enormous and far from unjustified confidence in their own technical abilities and those of the experts they committed their fortunes to, an unshakable optimism about their growth prospects and a conviction that they and the commissions that regulated them had a community of interest. They would soon learn otherwise.

The first commercial reactors in the U.S. were turnkey plants, built at fixed prices and turned over, ready to go, to their owners. In the Fifties and Sixties, General Electric and Westinghouse built 21 of them. The first plants cost more than their sponsors intended—as much as $800 million, according to one estimate—but they did their job well enough to persuade the utilities that nuclear power would be cost-effective. Nuclear power was not an unmixed blessing. It involved capital costs higher than for oil or coal, but its fuel costs were low, so low that promoters claimed it could practically be given away.

The electric utilities burst into the nuclear age with an enormous confidence in their own technical abilities.

Impelled by evangelism, optimism and seemingly irresistible economics, the nuclear bandwagon began to roll, and in the late Sixties and again in the early Seventies the orders began flooding in. But the suppliers had learned their lesson. The new generation of plants would be built under reimbursable-cost-plus-fixed-fee contracts. Without that, the nuclear power program would probably have sputtered out in the mid-Seventies, when costs lurched out of control.

At the time, these new plants seemed priced reasonably enough, costing maybe $200 million to $300 million apiece, a sizable but hardly insupportable commitment for a utility to take on. And the technology seemed not all that exotic. As reactor manufacturers explained it, a power plant was a power plant, and nuclear fission was just another way of heating water.

Well, even in the late Sixties it should have been clear that heating water with nuclear fuel was infinitely more complex and sophisticated than doing it with coal, and complexity meant cost. Perhaps the clearest signal was that coal remained competitive, so competitive that, as the nuclear program gathered momentum, most of the new plants had to be scaled up—to maybe 1.2 million kilowatts—to retain their cost advantage. In scaling up, however, the utilities were moving into unexplored territory. Nobody knew what the design problems were or, worse, what they were going to become. Says J. Christopher Young, senior vice president of Donaldson, Lufkin & Jenrette, "The assumption was you had a mature technology when in fact it was still evolving."

The new nuclear plants, according to Atomic Industrial Forum estimates, embody 50% to 85% more design work, more hours of craft labor and more materials than the earlier generation of nuclear plants—5 million to 6 million feet of cable, 30,000 pipe hangers, 300,000 cubic feet of concrete, millions of parts altogether. "In a big coal plant," says Duke Power Executive Vice President Warren H. Owen, "you would have no more than 200 critical pipe hangers. In a nuclear plant, you need 30,000. In a coal plant, you used a half-hour of engineering time and 2 hours perhaps to put those hangers up. In a nuclear plant, you spend 15 hours on the hanger design, 75 to 150 hours to put them up. So you've got more than 100 hours per hanger and 30,000 to put up."

The industry, however, had little doubt about its ability to meet any challenge presented to it. As the Sixties ended, after all, electric utilities had closed out the most prosperous decade in their 100-year history. Year after year, the scale economies of power production enabled them to reduce the costs of producing power, and those economies were so accessible that even mediocre managements could partially achieve them.

Thanks to their declining costs, the utilities came to be thought of as a growth business, showing a return on equity, despite regulation, pretty much in line with the rest of U.S. industry. And with consumers getting the benefit of steadily declining power costs, most utilities succeeded in establishing a long-term community of interest with the politically sensitive state commissions that regulated them. Until the late Sixties at least, the commissions had little to do other than step in from time to time and order a rate reduction when returns got unconscionably high.

As these cost reductions began to tail off and reverse themselves in the late Sixties, the utilities and the commissions were able to work out a series of accounting accommodations—deferred-tax and flow-through accounting, for example—that enabled the utilities to keep their rates low (taking the political heat off the commissions) and their reported earnings high (protecting the utilities in the stock market). Later on, in the early Seventies, when energy costs first began rising rapidly, the commissions turned more and more to fuel adjustment clauses to enable higher fuel costs to be quickly passed along in higher rates. Later still, when rising construction costs began posing financial problems, a number of commissions even permitted the utilities to include a portion of their construction work in progress—CWIP, as it became known—in the rate base, on which they could earn a cash return. Consumerist pressures to hold rates down were rising, but the community of interest between the utilities and the commissions endured.

This genial climate was to play a considerable part in the miscalculations that followed. Thus, when demand slackened in the middle Seventies and the utilities' financial problems threatened to become acute, many companies did not hesitate to stretch out their nuclear programs. "They had every confidence that the old system would work," AIF President Carl Walske says, "and that

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when the plant was finished, and it was time to get it in the rate base, the regulators would put it into the rate base."

The utilities, after all, were a cost-recovery industry, whose executives did not think about cost the way executives in other industries did. When accused of committing $50 million of stockholders' money to a nuclear project the government was prepared to finance, the chairman of Consolidated Edison once shrugged and said, "Hell, it's only $50 million." And what was $50 million to a $3 billion company? But shrug often enough, and the cost begins to add up.

Utility executives did not think about cost the way executives in other industries did.

But why worry even then? Few utility managers thought demand growth would stay low. Electrical demand had been growing at 7% a year for over 40 years, and despite some fits and starts in the early Seventies, there was no reason to think that anything fundamental had changed. The energy crisis, in fact, made nuclear power more vital than ever. The Nixon Administration's 1974 Project Independence counted on nuclear power to provide 40% of U.S. electricity by 1990, 50% by 2000. "You were dealing with a mind-set that had no idea of what was down the road," says Salomon Brothers analyst Neal Kurzner. "If you said, 'Maybe you're a bit off,' they didn't care. They went ahead with their construction program."

In a program geared to a 7% annual growth pattern, however, the mathematics of miscalculating the market was awesome. At 7% annual growth, you needed to double your capacity every 10 years. At 3%, every 24 years. At 1%, every 70 years. After the second runup in oil prices, in 1978, utility executives had to accept the fact that something basic might be happening to demand, that all the nuclear capacity they were planning might not be needed until a decade or more later than they thought. The Tennessee Valley Authority canceled 8 out of 17 nuclear projects, Public Service Electric & Gas 5 out of 8, Duke Power 6 out of 13, Detroit Edison 3 out of 4. The cancelations continue.

Of all the woes that descended on the U.S. nuclear industry beginning in 1978—high inflation, high interest rates, slackening demand—none was to prove more traumatic than the accident at Three Mile Island on Mar. 28, 1979. On that day, a stuck valve and inadequately trained operating personnel caused the nuclear reactor to overheat dangerously. Though the reactor core was damaged, no one was hurt or even seriously endangered, but the accident demonstrated the fallibility of the utilities, the NRC and the manufacturers, and produced a public relations disaster from which nuclear power has not yet recovered.

Something rotten in Suffolk?

If it ever gets into operation, Long Island Lighting Co.'s $4.2 billion Shoreham nuclear power station will probably produce the highest-cost commercial nuclear power in the world—21 cents per kwh. The staff of the New York Public Service Commission regards Shoreham as the nuclear power industry's ultimate horror story. But William Catacosinos, Lilco's new chairman, says that if anything did go wrong—and he doesn't concede that—there was nothing that Lilco could have done about it.

The Shoreham plant made considerable economic sense. Long Island is the only geographic enclave in the U.S. totally dependent on foreign oil for generating electricity. In the late 1960s—commendable foresight!—Lilco set out to break that dependence with a 540,000-kw nuclear station at Shoreham in Suffolk County, later enlarged to 809,000 kw to improve its economics.

By the time Lilco got its construction permit—after year-long NRC hearings that Lilco describes as "the most contested hearings in the history of nuclear power"—the plant was already three years behind schedule. Lilco blames that delay for most of the problems that followed. But the argument doesn't really jell. Even Lilco has conceded that, because of safety-related modifications to its reactor containment structure, it wouldn't have been able to get the plant into operation before 1982.

At a milestone meeting at Hyannis, Mass. in November 1973, Lilco and Stone & Webster, the outside firm that served as architect/engineer and construction manager, set up an elaborate work schedule postulated on a two-shift operation. No matter that for three years thereafter the boilermakers' union refused to work two shifts; Lilco and Stone & Webster nonetheless stuck to the Hyannis schedule and fell further and further behind.

The PSC staff charged that Lilco didn't monitor Stone & Webster's engineering properly or supervise its design changes or manage procurement adequately. And when Lilco did interfere, the staff charged, it only made things worse by undermining S&W's authority. At the same time, the staff claimed S&W wasn't adequately staffed to support a tight schedule and that engineering design lagged behind construction and threw off the schedule.

Shoreham became notorious for the excessive amount of overtime Lilco was willing to pay, the amount of theft on the job and the amount of shoddy work that had to be redone. The staff conservatively estimated the cost of bad work practices alone at the Shoreham site—workers starting late and quitting early, extended coffee breaks, drinking and taking drugs—at $35,000 a day.

Progress was so unsatisfactory that in 1977 Lilco finally "lost confidence" in S&W as construction manager and formed a unit to handle the construction management itself. If the decision to switch contractors was good, the PSC staff nevertheless concluded that the decision to do the job itself was bad: "Lilco did not have personnel with the background and experience to function as construction manager of a nuclear plant."

The "telling culmination of the management inadequacies represented throughout," in the staff's judgment, was the series of problems Lilco had with its three Transamerica Delaval backup diesel generators. In 1975, before the equipment was delivered, S&W complained that the diesels hadn't been tested in accordance with the purchase specifications and so conceivably might be faulty. But somehow S&W never got the data to establish the integrity of the diesels and somehow failed to impress Lilco with its concern over their quality.

Though Delaval delivered the generators in 1976, Lilco didn't get around to putting them into service until August 1983. Then, during preoperational testing, the

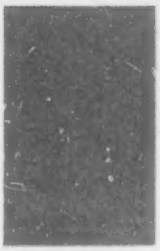
After Three Mile Island—TMI, as everyone in the industry antiseptically calls it—safety became an obsession. The NRC promulgated hundreds of new safety regulations between 1978 and 1983 to cope with contingencies ranging from earthquakes to missile strikes. Says engineering consultant James O. Love: "An implicit 'perfection standard' was emerging as the NRC's expectation and measuring stick." The utilities had no choice but to adjust, in some instances tearing apart nearly completed plants to conform to the changes, or redesigning plants just under way. The process seemed unending. "At the McGuire plant," says Bob Dick, Duke Power's construction vice president, "we were really putting in with one hand and taking out with the other."

Some utilities had risked starting construction with designs only 20% complete, rather than the 40% considered minimal, only to discover, with the NRC changes, that they were not even that far along. Florida Power & Light's much admired St. Lucie 2, which started out with a design 70% complete, wound up with a design only 30% complete. The logistical and morale problems were overwhelming. "These plants are so congested you can't be sure all the pipes are going to go where they're designed," says Bob Dick. "You design, you attempt to erect, you change, you analyze, and it may recycle two or three times."

"The work force becomes inefficient as a result of the delays," says Stone & Webster Senior Vice President John Landis. "You lose workers, usually the very best workers, and when you restart, the workers that remain make mistakes. The delays are, in my opinion, the most costly factor in the nuclear power economic picture."

There was another cost consequence of TMI, more subtle than delays as such but scarcely less profound. "After TMI," as AIF's Carl Walske sums it up, "the balance of decision-making power shifted sharply from the utilities to the regulators." The NRC itself didn't worry about the cost impact of the regulations it imposed; it wasn't supposed to. And under cost-plus contracts, of course, suppliers and contractors had virtually no incentive to be efficient; they were reimbursed for the costs of retrofitting NRC-dictated changes as they were for any others. The industry itself was on the ropes, and most companies were prepared to do whatever was asked of them, never mind the cost. When the PSC charged Detroit Edison with wasting money out of a "near-paranoid concern for environment and safety," utility Chairman Walter J. McCarthy readily conceded: "This is a charge to which we gladly plead guilty."

Many utilities were totally unprepared for proj-



The NRC didn't worry about the cost impact of the regulations it proposed; it wasn't supposed to.

Allan Tannenbaum/Sygma

Entry gate at Lilco's Shoreham nuclear plant

crankshaft on one of the three diesels failed, two others developed cracks, and Lilco found itself with millions of dollars' worth of defective equipment on its hands. It thought it had a warranty for one year after the equipment went into operation, but Delaval said the warranty was good for one year after the plant was originally scheduled to go into operation in September 1977.

So Lilco laid out $91 million for three new generators from Colt Industries and a building to house them. But with new crankshafts the Delavals proved usable after all. Lilco had spent a needless $91 million and ended up with three to four times as much backup power as it needed. The PSC staff also claimed that the delay involved in getting the defective diesels into service had increased the plant's capital cost by $539 million.

The PSC, obviously having begun to think there was something rotten in Suffolk, began prudency hearings in October 1981 to find out what had gone wrong. By stacking Shoreham up against both the industry as a whole and a similar nuclear plant—Pennsylvania Power & Light Co.'s Susquehanna 1—the PSC staff concluded that Lilco's management was seriously deficient. In addition to its scheduling and diesel problems, Lilco's engineering and construction man-hours were so excessive, the staff argued, that only $2.3 billion of Shoreham's $4.2 billion cost could justifiably be included in the rate base.

Lilco scoffed that the staff seemed to think all nuclear plants were alike, but they obviously were not. Lilco claimed it had conducted its nuclear program more or less as every other utility had, and if it hadn't done as well, the reason was that Lilco wasn't like other utilities. Lilco didn't have the climate, the labor, the previous nuclear experience, the work rules, the work ethic or the environment other, more successful nuclear utilities enjoyed. You couldn't help wonder, in fact, whether conditions on Long Island weren't so unfavorable to the construction of a nuclear plant that any prudent management would have sought some other solution.

Meanwhile, power consumption in Lilco's Long Island territory continues to grow so briskly that sometime later this year Lilco will fall below the reserve requirements mandated by the New York State Power Pool. That may be management's strongest argument for getting Shoreham into operation, and as quickly as possible.

"This is a finished plant," says Bill Catacosinos. "If the Shoreham situation is resolved, Lilco will be on its way to financial health." That depends, of course, on just how much of Shoreham's cost the PSC will accept. If the PSC staff proposal wins out, Bill Catacosinos concedes, Lilco is bankrupt.—J.C.

ects requiring management skills of such a high order. The NRC shut down Marble Hill and South Texas for over a year because construction managers there had problems pouring concrete correctly. Contractors had difficulties welding metal almost everywhere—Marble Hill, Zimmer, Shoreham, Clinton, Byron, Limerick, Nine Mile Point, take your pick. They couldn't always install electrical equipment properly, either, or follow the specifications for steel. At Commonwealth Edison's Byron plant, the NRC chewed out the contractors who did the electrical, piping and duct work, and even banned one from supplying safety-related components to the industry. At Nine Mile Point, rejection rates in final welding and mechanical aspects for poor workmanship ran around 38%. Poor craftsmanship, an NRC study concluded, "was an effect, not the cause. The principal underlying cause . . . was found to be poor utility and project management."

The nuclear program is falling apart, not on nuclear technology. It's falling apart on conventional construction.

"We developed the whole nuclear technology in the U.S.," laments New York consulting engineer Gerard C. Gambs, "and now the nuclear program is falling apart. Not on nuclear technology. It's falling apart on conventional construction, which I think is absolutely incredible."

Many companies even failed to comply with the NRC's requirements for documenting that a plant had met the proper quality standards. Granted, those requirements were exceptionally onerous, resulting in paperwork by the carload, microfilmed records by the millions. But the duty was clear. The penalty for failure to comply was severe—lacking that documentation, the NRC refused to accept the quality of the plant. Paperwork failure, nevertheless, was endemic—at Illinois Power's Clinton plant as at Duke Power's Catawba, at Texas Utilities' Comanche Peak as at Gulf States' River Bend, at Kansas Gas & Electric's Wolf Creek as at MSU's Grand Gulf.

The ineptitude had no pattern, and virtually anything could go wrong, and did.

The utility business may not have attracted the most talented managers in U.S. business, but most of them recognized that they didn't have the skills to handle the job and hired what they thought were the best in the business to do it for them—big guns like Stone & Webster, Bechtel, Ebasco, Sargent & Lundy, GE, Westinghouse, Combustion Engineering, Babcock & Wilcox.

But the presence of any one of them on the job was no guarantee of efficient performance. Too many hands play a part in a nuclear project for any one of them to be decisive—as many as a dozen contractors and subcontractors in most projects, ranging from the architect/engineer who oversees the design and engineering of the project to the construction manager who implements the design, presiding over everything from procurement and the pouring of concrete to the installation of the mechanical and electrical systems.

Thus, both Cincinnati Gas & Electric and Public Service of Indiana hired Sargent & Lundy, the architect/engineers of Commonwealth Edison's highly successful nuclear program, to duplicate that success at the Zimmer and Marble Hill plants. But it was Edison's role as construction manager that made the big difference. PSI acted as its own construction manager at Marble Hill, while CG&E hired the Henry J. Kaiser Co., which had no previous commercial nuclear experience, to build Zimmer. Both plants were abandoned, Zimmer because its safety and quality could not be established, Marble Hill, after some quality problems, because it ran out of money.

Houston Lighting & Power turned to Texas' own Brown & Root, which offered "full responsibility" contracts to engineer and construct nuclear plants. But B&R's engineering couldn't keep up with construction, or so HL&P complained in its suit against the company. The project was halted for two years while B&R corrected faulty concrete and welding work, and the NRC complained constantly about the quality of its work. HL&P complained that, after nine years, B&R had completed less than half the engineering and one-third of the construction. An outside consultant found failures of the most basic kind: defective systems integration and overview function in the design process, lack of a well-thought-out, consistent basis for the work, failure to see that subcontractors had met design specifications, failure to document the work done.

It might be noted, in fairly assessing the dismal record, that Brown & Root had never built a nuclear plant on its own before. Neither had Kaiser. But what is to be said for Stone & Webster, which took credit for some of the most successful nuclear projects in the Sixties and early Seventies, yet went on to preside over three of the most costly and troubled plant projects still under construction—Lilco's Shoreham, NM's Nine Mile Point and Duquesne Light's Beaver Valley?

The staff of the New York Public Service Commission chewed out Stone & Webster for major deficiencies in its role at Shoreham, while the NRC complained about quality control deficiencies at Nine Mile Point. Shoreham had plenty of problems *(see box, p. 88)*, but S&W's John Landis suggests that they were pretty much par for the course. "We didn't have the same magnitude of problems elsewhere that we did at Shoreham, but there were similar problems: a lot of intervention, a lot of starts and stops. Some lack of communication among the parties involved. High labor costs and, of course, construction in a period when the effects of TMI were particularly harmful."

The bungling the industry was capable of boggles the mind. In the Zimmer control room, according to a study for the Ohio PUC, the control panel would catch fire when the alarm nodule lights went on close together, so that in an emergency the panel would have knocked itself out and the staff would have been unable to control the plant. But nobody worried about that. Many of the lights had burned out, and the staff had unplugged others to decrease the risk of fire.

The ineptitude had no pattern, and virtually anything could go wrong, and did. How could an experienced contractor like Bechtel have prepared the Midland plant site so poorly that the diesel generator building began settling excessively? How could Bechtel have installed the reactor backwards at San Onofre? How could Brown & Root have got the reactor supports 45 degrees out of whack at Comanche Peak? How could experienced operators pour defective concrete at Marble Hill and the South Texas project? How could the NRC itself approve designs for the Mark II reactor when what Grand Gulf was building was a Mark

Troubleshooter

William Derrickson is the superman of the nuclear utility industry these days. As general manager, he brought in Florida Power & Light's St. Lucie 2 plant close to cost ($1,795 a kilowatt) and on schedule (six years). Since it went on line in 1983, the plant has operated at 92% of capacity, well above the industry's 58% average.

Derrickson is now at Public Service of New Hampshire, as vice president for nuclear power, to oversee completion of that company's financially troubled Seabrook nuclear plant. Budgeted originally at $970 million, the two-unit, 2.3-million-kw plant promised to cost over $9 billion complete when it was shut down last spring for lack of money. Construction resumed at a $4 million-a-week level last July, but PSNH is having so much trouble finding the money to finish unit 1, it's almost certain unit 2 will be canceled.

Seabrook's Bill Derrickson

Seabrook 1 is already 83% completed, with 99% of the materials on site, rusting, awaiting more money. When and if that appears—the financing is agonizingly slow—it will take $830 million and maybe 18 months to get the plant into production. Derrickson has no doubt that he can bring the project in under its current $4.5 billion budget, unless the financing falls through again, but the shutdown and slowdown have already added another $400 million to the cost of the project.

In taking over for PSNH, Derrickson drastically revamped the way United Engineers managed Seabrook. United had hired subcontractors like Fischbach & Moore and Johnson Controls, and they in turn hired the craftsmen to do the job. But Derrickson wanted greater control, and United now employs those craftsmen directly. "We're setting up things we know worked in the past because we believe they will work in the future. They're working already.

"The trick is to be sure, first of all, that the job is planned and scheduled—that we know what we want to do when. Our operating and startup people tell us what is the sequence of things to be done. What are the first systems, the second, right on through, and we put in the construction duration and the engineering, the materials delivery requirements—pumps, pipes, instruments, cubic yards of concrete. But we start from the end of the job backwards, working toward the operating objectives. On the basis of industry and local experience, we know how many man-hours per foot of cable it should take, how many man-hours per foot of weld, and so forth, and we staff accordingly."

Given the pressure of compounding interest charges, Derrickson explains, making the schedule is everything. If you don't make it, you're not going to control your costs. To ensure that they stay on schedule, Derrickson's craftsmen work in two shifts, five days a week, eight hours a day. No overtime. Derrickson saves Saturday for contingencies—an NRC-dictated change, say—and has allotted $170 million to pay for them.

"What we've done," he says, "is develop a system that gives us the flexibility to absorb changes and not impact the schedule." At St. Lucie, for instance, TMI changes boosted the cable required, from 3 million feet to 4.5 million feet. Derrickson was able to stay on schedule by working Saturdays and enlarging the second shift. "There haven't been any regulations affecting Seabrook coming out of the NRC since the summer of 1983, so if there are no more, our contingency system will cover anything we didn't pick up."

Derrickson has never been one for blindly adopting everything the NRC happens to order. FP&L maintained an office right across the street from the NRC in Bethesda, Md. and PSNH has now taken it over, so he is always alert to what the NRC has in mind. "If we had a problem with a regulation, we sat down with the NRC and said, 'Do we really have to do this one, or can we do it this way instead?' The plant might not accept what's been proposed. But the regulations are what they are, and we will comply with them one way or another."

Maybe the trick is in knowing when to say to hell with the schedule. At St. Lucie, when the pipefitters' union began dropping oil and paint on the quality control inspectors as part of a drive to organize them, Derrickson promptly shut down the whole project. "We just told them, 'No more! We can't justify paying until everybody can come back and put in an eight-hour day doing the job.' It took about three weeks for them to come around."—J.C.

Lacking knowhow, utilities hired experts to manage nuclear projects. But the experts themselves all too often bungled the job.

III? How could design control have been so lax that PG&E used the wrong drawings in calculating seismic response for the steel in the Diablo Canyon containment building?

The NRC has a partial answer. "In some cases," an NRC study concluded, "no one was managing the project, the project had inertia, but no guidance and direction." The NRC's diagnosis may seem self-serving, but an Office of Technology Assessment study last spring came to the same conclusion: "Inadequate management has been one of the major causes of construction cost overruns and erratic operation."

In the end, things sometimes got so bad the utility managers themselves were forced to intervene. Lilco took over from Stone & Webster as construction manager at Shoreham. Houston Lighting dumped Brown & Root for Bechtel and Ebasco. Public Service of New Hampshire moved in on United Engineers. CG&E replaced Kaiser with Bechtel. PG&E even hired Bechtel to complete the job PG&E itself had bungled.

Even the most carefully managed projects ran into trouble. At Georgia Power's Vogtle plant, for example, 12,000 socket welds had to be reworked and reinspected. Duke Power, the most successful of the lot, has had problems with quality control like everyone else.

And so have some of the industry's most respected suppliers—most notably the General Electric Co. Seven utilities committed themselves to GE's Mark II containment system, only to discover, back in the mid-Seventies, that the reactor containment structure was defective. In the interest of safety, the containment had to be redesigned to contain the violent forces that could be generated in the event of an accident, and that took time and money. How much money the utilities decline to say, but the modified design was not approved by the NRC until 1981. And the changes were certainly costly. A study done for the Ohio PUC urged that Cincinnati Gas & Electric sue GE for the $360 million the Mark II modifications eventually cost the company.

Most disheartening of all, perhaps, are the instances of mendacity and worse in U.S. nuclear projects. A number of major contractors allegedly rigged bids at the Washington Nuclear, Diablo Canyon and Marble Hill projects, and some have gone to jail for it. Quality control inspectors have been intimidated, documents have been forged, operator training records have been falsified. Metropolitan Edison pleaded guilty to using faulty test procedures at TMI. Wolf Creek even managed to document as inspected a weld that didn't exist.

One conclusion seems inescapable: Any utility that failed to involve itself directly in every aspect of the project was likely to end up with a mismanaged project. And as Lilco and PSI made clear, even that may not be enough. Look at the nuclear table on page 85: On five of the eight projects likely to come in for less than $2,000 per kilowatt, the utilities involved handled their own engineering and construction. So it's a catch 22 dilemma. Lacking knowhow, utilities hired experts to manage nuclear projects. But the experts themselves all too often bungled the job.

Apologists argue that most of the nuclear industry's troubles were simply beyond the industry's control. Can't keep your costs under control? Can't meet your construction schedules? Blame the NRC, blame the antinuclear forces, blame inflation, blame interest costs. Don't blame the fact that you haven't the slightest idea of how to control costs or schedule production. " 'Regulatory problems' is a kind of a catchall for all the cost overruns," says one consultant who understandably wishes not to be named. "They made mistakes and could have done a better job. The construction mentality is to build the plant and don't let paperwork slow you up."

But the NRC's requirements, while burdensome and sometimes outrageous, were not insupportable, and some utilities and construction firms had considerable success in coping with them. Arizona Public Service even anticipated many of the design changes the NRC imposed after TMI—simply because it had committed itself to building the best plant it could. And Duke Power has consistently brought in the lowest-cost and most efficient plants in the industry.

The project that serves as a model—and a reproach—to almost everyone is Florida Power & Light's St. Lucie 2 project. Despite post-TMI design changes and a brutal hurricane, St. Lucie 2 was built in six years at a cost of only $1,795 per kw. FP&L had nuclear experience, and much of the design was complete when construction began. But management made the difference. "They expected the NRC to respond to the schedule," says Russell J. Christesen, president of Ebasco Services, the engineering firm that designed and built the plant, "and whatever the NRC had to do, the company made happen. Current regulatory procedures need not necessarily preclude meeting construction schedules and budgets."

3 Points of no return

What the utilities, the contractors and the suppliers began, the state regulatory commissions finished. High inflation and higher interest rates exploded the costs of the nuclear program and ultimately dissolved the community of interest between the regulators and the utilities.

Even before TMI, the costs of the industry's nuclear program had been rising faster than prices in the economy at large, faster even than costs in the construction industry as a whole. The effect of everything that went wrong after TMI—every schedule that was missed, every design that was reworked, every pipe hanger that had to be ripped out and reinstalled, every quality problem, every stretch-out, every postponement, every legal or antinuclear delay—served to double and triple these costs. Cincinnati Gas & Electric's Zimmer plant, for instance, started out in 1969 costing $240 million, was budgeted at $500 million by 1975, $1 billion by 1980 and $1.7 billion in 1982, with an additional $1.4 billion yet to be spent when construction was abandoned in 1984.

NRC regulation was responsible for at least part of these cost increases. But the accounting

The best

If any utility was equipped to cope with the challenge of the nuclear age, that utility was North Carolina's Duke Power Co. Dominated by engineers for all of its 80 years' existence, Duke has an engineer's conviction that the best-engineered plant inevitably also will be the most efficient, lowest-cost, most reliable and, in the end, most profitable. Things have pretty much worked out that way.

Duke has put five nuclear units into operation so far, the latest of which, McGuire 2, went commercial last March at a cost of a mere $932 a kilowatt, less than one-third the cost of the average new U.S. nuclear plant, roughly 60% of what the Canadians spend, and pretty close to what the French plants cost.

Duke's geographic location doesn't hurt any, of course. Its labor costs (mostly nonunion) are considerably lower than those in such places as New Jersey or New York. Nor has Duke been subject to as much environmentalist opposition as some utilities have been, partly because the company has made an effort to avoid it.

Duke Power's Catawba plant at Lake Wylie, S.C.

But what really makes its commitment to excellence pay off is that Duke Power is not just an electric utility. It's also an engineering and construction firm. It doesn't subcontract even its biggest jobs, it does those jobs itself, including the engineering and construction work. The engineering and construction staff is on the Duke Power payroll, receiving the same wage scale and fringe benefits as the rest of its employees. Although Duke's way may cost somewhat more, it provides a skilled, experienced and permanent work force that has moved from plant to plant for nearly 20 years now as the company's nuclear program has progressed, first from Oconee, completed in 1974, to McGuire, 1984, then to Catawba, scheduled for 1986.

"The fact that we design, build, test, start up, operate, maintain with essentially the same people is very beneficial from a cost standpoint," says Bob Dick, the engineer who oversees Duke's nuclear construction program. "I feel sorry for people who have 15 contractors they have to interface with. Everybody here knows the way we do things.

"We measure productivity at the beginning and the end of the day, before lunch and after lunch, always looking for small things to make corrections on. We don't perform any work without written procedures and instructions. We originally assumed that, given an experienced crew with experienced supervision, certain tasks were just part of the skill of the craft. But you can't depend on that. We have an intense pride in being the best. It's the tradition, the culture."

Duke also has run a wholesale electrical distribution business for years. As a result, as the nuclear program got under way, the company already had the skills it needed for handling procurement. This has enabled Duke to buy more cheaply than it would have through middlemen, and it has given it greater control and knowledge of its costs than it would have had otherwise. Thus, in design, construction and procurement, Duke does virtually everything itself. "If anything goes wrong," one executive points out, "we know who's responsible. It's us."

Like everyone else in the business, Dick complains about NRC regulation. The agency, he says, sometimes seems more interested in documentation than in quality. "We have actually cut perfectly good welds out of pipes because a piece of paper in the inspection record was misplaced four years ago." But those are the rules of the game, he says, and you try to play by them.

Duke's nuclear program was one of the first to run into financial problems, back in the mid-Seventies, so that it learned early to cut its ambitions to suit its resources. It slashed $700 million out of its construction program at that time and succeeded in peddling a 75% interest in the new Catawba plant to a group of municipal and cooperative electric companies that could finance their investment with low-cost, tax-exempt bonds. Later, when demand began to fall off, Duke was reasonably quick to curtail and then cancel its Perkins and Cherokee projects. Perkins was scheduled to come into production in the early Eighties, Cherokee in the Nineties.

So you do the job right and you do it within your means, or you don't do it. And it works. The three Oconee units cost $194 per kw, the two at McGuire $849, and the two at Catawba $1,703, with capitalized interest accounting for over one-third of the difference between McGuire and Catawba. But for all its success, Duke no longer considers nuclear power a choice. "We would not have gone into the nuclear business if we had realized the instability of the licensing process," says William Grigg, Duke's treasurer. "A nuclear plant with all the regulatory uncertainties, all the investor concern, the environmental concerns, I just don't think would be a viable option for us."

As it happens, Duke is unlikely to need any new power for a decade. When Catawba is complete, Duke will have 49% of its capacity in nuclear, and a comfortable 31% reserve capacity. Its next big venture is the Bad Creek pumped storage project scheduled for 1991. Where Duke's power will come from, the next time it goes looking for some, may depend on how successful the U.S. has been in learning from the mistakes of the past.—J.C.

practices prescribed by the state regulatory commissions were responsible for even more.

If an industrial company builds a plant, the interest cost of any debt it incurs generally goes into the profit-and-loss statement as a charge against income. Not in utility accounting. Today's customers, the regulators' argument runs, shouldn't be required to pay even the interest cost of tomorrow's power. A power plant usually has to be "used and usable" before the investment can go into the rate base and earn a return.

Instead of charging off interest costs, the utility imputes an interest charge to the money it has invested in a project based on its average cost of capital, capitalizes the amount (that is, adds it to the total investment) and reports it as a noncash credit in its income statement. The credit is called AFUDC, Allowance for Funds Used During Construction. AFUDC increases reported net income, but it also increases the cost of the project. Impute a 10% or 15% return to a $2 billion investment and then capitalize it, and the cost increases by $200 million, $300 million a year. Worse, the capitalized amount is then imputed a return of its own. And so the costs of an unfinished plant expand and compound, and the longer a project takes, the more the cost compounds.

If many companies were derelict in monitoring their contractors, many rate commissions were equally derelict in failing to monitor the utilities.

Take FP&L's St. Lucie 2 plant. "The interest costs were $300 million," says project manager William Derrickson *(see box, p. 91)*. "If we had taken two or three years more to build it, even if the bricks and mortar were the same, we would probably have incurred up to a billion dollars more."

As construction dragged on, AFUDC came to provide a major part of utility earnings—close to 100% for outfits like Lilco, 113% for Kansas Gas & Electric, and 126% for Public Service of New Hampshire. But, though the companies looked healthy, there was no cash behind these paper earnings. Utilities in such a bind had to finance their construction programs out of the cash their operating properties were generating, and when that wasn't enough, borrow money, sell more common or preferred or even cancel the dividend. When inflation, high interest rates and delay push the cost of a project into the billions, that often gets pretty difficult.

The Wall Street firm of Donaldson, Lufkin & Jenrette calculates that current investment in ongoing nuclear projects accounts for 78% of total net plant for PSNH, 75% for El Paso Electric, 64% for Louisiana Power & Light/New Orleans Public Service, 50% for Kansas City Power & Light and for Union Electric, 49% for Toledo Edison. "If you only have half of your capital generating cash," says DLJ's Christopher Young, "you're not really solvent."

For many companies in many states the cash flow problem has been eased a little by partial CWIP—construction work in progress—providing at least some return on a small portion of construction cost allowed in the rate base. But on an investment of several billions, even 20% is far from enough and not much more relief from that quarter can be expected. Regulators saw what was coming. As costs began to rise into the billions and the utilities began arguing for more generous CWIP, the state commissions became increasingly unsympathetic. Washington State, for instance, recently banned CWIP by law.

In such circumstances, poor management is not simply failing to develop a construction project properly. It is also failing to recognize that you lack the financial resources to fund a project or, having recognized it only belatedly, failing to shut the project down. Some utility managers accepted their financial limitations and acted accordingly—Boston Edison and Dominion Resources, for example. Many more did not. "In terms of its financial viability, Public Service of New Hampshire should never have built Seabrook," DLJ Vice President Mariel Clemensen says bluntly about one case in point. "It simply could not support close to 80% of its capital in a construction project. We can't blame regulatory reluctance for the problems the companies got themselves into."

The chairman of Michigan's PSC, Eric Schneidewind, couldn't agree more: "We don't manage the utilities. We manage ultimately the amount of money they can collect, but we don't tell them you must or must not use it in certain ways. That's the reason they get paid."

Perhaps so. Yet the commissions do manage to a degree, and so they are not completely off the hook. Many commissions, after all, can approve or disapprove the financing for utility construction programs. Just as a good many companies were derelict in failing to monitor what their contractors were doing, a good many commissions were equally derelict in failing to monitor what the utilities were up to. If completion of a project was in the best interest of the ratepayers, even the normally difficult Massachusetts commission has had to concede, a utility was entitled to expect regulatory support. But all too often, it failed to get it.

The commissions are now in a box no matter what they do. With interest capitalized rather than written off, rates have to rise sharply when a new and very much higher-cost plant representing a major proportion of assets enters the rate base. It's not the cost of the plant as such that makes the difference, but the cost of the plant in relation to the rate base. Thus Niagara Mohawk may need only a 19% rate increase to account for its $5.1 billion Nine Mile Point plant, whereas Union Electric may need 42% and more to offset Callaway, which cost only half as much. Big companies like PG&E or Duquesne Light can absorb such increases with ease. But for smaller companies, the projected impact is chilling.

To mitigate the rate shock of these new plants, some commissions have been turning to various schemes for "phasing in" higher costs over a period of years. Rather than posting a single large rate increase, Kansas Gas & Electric will probably bring in Wolf Creek in stages—39.4%, 11.5%, 10.8%, 8.2%, 4.6%. Lilco has a similar plan, and Connecticut utilities are considering a similar phase-in for Millstone 3 and Seabrook 1.

For the utilities and the commissions, the honeymoon is over at last. "This is supposedly a cost-recovery industry," says Edison Electric Institute Vice President Richard Braatz. "Yet the commissions practice cost deferral. They've deferred so much by now that the pigeons are coming home

Who's holding the bag?

Back in 1978, when oil prices were soaring, the 24 rural electric cooperatives of the Wabash Valley Power Association decided to take up a 17% interest in Public Service of Indiana's new Marble Hill nuclear plant. Seven years have passed, and Wabash Valley still doesn't have its nuclear plant, but it does owe the Federal Financing Bank the $478.8 million it borrowed for Marble Hill, which it can't afford to pay. Public Service of Indiana formally abandoned Marble Hill last November, and Wabash Valley already has defaulted on two quarterly interest payments. And, according to Jack Van Mark, deputy administrator of the Rural Electrification Administration, which guaranteed Wabash Valley's federal loan, "Foreclosure is a very serious possibility."

How did WVPA get into this mess? "In the mid-Seventies," explains General Manager Edward Martin, "during the energy crisis, we looked at Marble Hill as a long-term cost-controlling adventure—or venture, rather." He was right the first time. Until then Wabash Valley had always bought power wholesale from investor-owned utilities and sold it to distribution cooperatives in northern Indiana's rural areas. WVPA already purchased half its power from PSI. With prices rising and energy increasingly short, it reasoned, investing in Marble Hill would enable Wabash to get the same power for maybe 2.2% less than it would pay wholesale. That seemingly small difference amounts to $128 million over 13 years.

Transmission towers in electrical co-op country

Marble Hill was PSI's first nuclear project, but it looked plausible enough. The plant was a replica of the Byron plant being built by Commonwealth Edison, and Edison had been as successful with nuclear power as anyone. Besides, WVPA officials told themselves, there was no other prospect for low-cost power.

And so, in 1978, WVPA arranged for a $361 million low-cost credit line from the Federal Financing Bank and turned over a first payment of $34 million to PSI, which would have full management of the project. WVPA felt it had to keep faith in the project even after the Three Mile Island accident, which occurred in March 1979. "Three Mile Island scared us all to death," Ed Martin explains, "but what do you do? It's not like someone in the stock market. You can't just take your money and go. This was a major commitment with literally thousands of jobs at stake."

Marble Hill's troubles began almost immediately thereafter. The concrete for the plant was defective, honeycombed with voids. In August 1979 the Nuclear Regulatory Commission imposed a stop-work order on all safety-related construction. The order was not fully lifted for 30 months. But WVPA doggedly stuck to its investment. Cost estimates for the plant rose from the original $1.8 billion to $3.4 billion in 1980, $4.3 billion in 1981 and $5.1 billion in 1982, while commercial operation of the two-unit plant was delayed four years, to 1986 and 1988. To cover its share of the escalating cost, WVPA received another $588 million credit line from the Federal Financing Bank, guaranteed by the REA, in 1980. Even at $5.1 billion, WVPA expected to save $198 million compared with buying power from other sources. In any case, WVPA thought that staying in was better than forfeiting its share of the plant's output and still having to pay off the money it borrowed. Which in the end is what happened.

In early 1983 Marble Hill was in trouble again. PSI suspended work on the plant's electrical, heating, ventilating and air-conditioning systems, faced further delays from a revision in the structural steel requirements, and finally in October announced costs had risen to $7 billion and commercial operation would be delayed until 1988 and 1990. Only months later, it suspended construction entirely. In November 1984, after having laid out $2.3 billion, PSI formally canceled the project.

Which left Wabash Valley holding a large bag. WVPA has already defaulted twice on repayments on its $478.8 million debt. Both times the REA has bailed it out. But what happens if the REA lets Wabash Valley go bankrupt? Unlike investor-owned utilities, a Rural Electric Membership Cooperative has no shareholders to bear the loss. Ed Martin has said the REA will have to shoulder WVPA's loss. The federal government encouraged nuclear projects in the mid-Seventies, after all, and the REA went along in guaranteeing the loans.

"Poppycock!" snorts REA's Jack Van Mark. "Wabash entered into the investment free of any coercion." Van Mark insists that WVPA is just going to have to pay for the loss through the rate structure. The REA could allow WVPA to stretch out its loan repayments, but it couldn't afford to set a precedent for bailing out co-ops with financial troubles. Raising rates to meet that obligation would be a shocker. Wabash has estimated that putting $450 million into the co-op's rate base would mean a 48% increase in wholesale rates.

Whatever the outcome, WVPA's members will be paying one way or another for their nuclear foresight for years to come.—Catherine Yang

The utilities were beginning to discover the commissions were no longer the rubber stamps they once were.

to roost. What you're seeing is a realization that management has no assurance they can recover their costs. As a result, you are going to see an eroding in the commitment to service."

For some utilities it already may be too late for improvisations like phase-ins. Once they passed the one-third or halfway point in the project—the point of no return—these utilities could not afford to write off an unfinished plant. So they pushed ahead, hoping to finish the plant as quickly as possible, get it into the rate base and begin recovering their money. In several states—Ohio, Oregon, Missouri among them—they had no choice at all, because by law they could not recover the cost of "unused" properties under any circumstances.

All too often, as the utilities raced for completion, construction schedules kept lengthening and costs went on rising with no end in sight. But even when they did get the plant completed, the utilities were beginning to discover that the commissions were no longer the rubber stamps they once were. You could not put a plant into the rate base unless it was "usable"—that is, built to serve an existing demand. And so, last August, for example, the Pennsylvania Public Utility Commission in effect disallowed $287 million of the cost of PP&L's Susquehanna 1 on the grounds that the plant provided excess capacity, and it may look no more favorably on Unit 2, which recently went into operation. The Texas PUC disallowed $166 million of the cost of Houston Lighting's abandoned Allen Creek project, claiming the company should have canceled the project two years earlier, and then cut HL&P's allowed rate of return as a penalty for poor management. In New York, as noted, the PSC staff wants to disallow $1.5 billion of Lilco's Shoreham costs on the grounds that they were imprudently incurred. In California the $2.5 billion overruns in PG&E's Diablo Canyon costs over the past eight years may never find their way into the rate base.

For the first time the threat of bankruptcy has become a reality for a handful of major companies.

And that was hardly the worst. A number of companies lost the gamble and ran out of cash before they could finish their construction programs—Consumers Power, Lilco, Public Service of Indiana, Public Service of New Hampshire. "The markets tended to close," says DLJ's Young. "The only way you can fund it yourself is to stop paying your common dividend. Rate relief doesn't do it because it takes too long to recover those dollars. And once you cut the dividend, the market really closes. You can't sell common or preferred, and you can only marginally sell bonds. So now you can't fund the completion of the project, and you have to abandon it. But if the PSC doesn't accept its value, you have to write off the rest, and the writeoff can be so substantial you're brought to the brink of bankruptcy."

But in the end some companies had no choice. Over the past three years, the Washington Public Power Supply System stopped work on two units it had under construction, canceled two others and defaulted on $2.2 billion in bonds. A year ago, CG&E and its partners in the Zimmer project gave up and decided to convert the site to coal. Public Service of Indiana first suspended and then, last year, canceled Marble Hill, 50% complete. In June Consumers Power halted Midland 2, 85% complete. Except for Zimmer, which was halted because it could not meet the NRC's quality standards, all these plants were canceled, because their owners could not raise the money to finance them.

Those are extreme cases, all of them, but they embody the problem companies everywhere face. Utility analysts expect that most of the second units still nominally under construction will be canceled as well—Grand Gulf 2, Limerick 2, Perry 2, Seabrook 2, WPPSS 3. Clinton, Grand Gulf 1, Waterford and River Bend, among others, still suffer recurring cash shortages. Lilco appears to have solved its financing problems at the moment, but whether its Shoreham station, now virtually complete, will ever go into commercial operation is anybody's guess *(see box, p. 88)*.

And so for the first time the threat of bankruptcy has become a reality for at least a handful of major electric companies. A bankrupt utility is obviously not going to suspend operations, but established procedures for utility bankruptcies, unlike the railroad industry, don't exist. Nobody is eager to deal with such questions as who—a utility regulator or a bankruptcy court—has primary jurisdiction over utility property, who has the authority to dispose of assets, repudiate power or fuel contracts or even, conceivably, set rates.

Nobody knows either what will happen to a utility's costs in bankruptcy. "While the lights may stay on in bankruptcy," according to Jay Worenklein and Glenn Gerstell, utility and bankruptcy experts at Milbank Tweed, the New York law firm, "the costs may be higher, the service less reliable and the economic environment less attractive to new business." With inordinately high-cost plants such as Shoreham and Seabrook, it's not inconceivable that in the short run the consumer would be better off if bankruptcy forced a drastic scaling down of all the companies' debts. Their debt burdens aside, after all, both Lilco and PSNH are demonstrably viable companies.

Nobody wants to see the utilities go bankrupt. The states would lose tax revenue and probably jobs. A Consumers Power bankruptcy would even jeopardize the $108 million in pension fund money that the state of Michigan has invested in CP bonds. Even the tough-minded New York PSC ordered a rate increase to keep Lilco from bankruptcy. Large industrial customers have been paying their utility bills early. Suppliers have been letting utilities pay their bills late. And last December a group of industrial customers even supported Consumers Power's petition for a rate increase to avert bankruptcy. So chances are the utilities in trouble will somehow be kept afloat.

The repercussions of even a single bankruptcy could be fairly widespread, undermining the integrity of utilities everywhere and demonstrating that the unthinkable needed to be thought about after all. "If New Hampshire were to fail," asks DLJ's Chris Young, "and the capital market were really to come to grips with the fact that a utility can fail, could Gulf States finish the financing required for the River Bend project? Or Middle South that needed for Grand Gulf or Waterford?"

There is one other avenue left the utilities. If they can't recover their costs through the rate

structure, some state commissions have argued, they conceivably could recover them through the courts. That's why everybody in the industry these days lives under the threat of litigation. Dow Chemical is suing Consumers for the $60 million Dow says it wasted on cogeneration equipment for the aborted Midland 1 plant. Consumers, in turn, is countersuing for the $460 million Dow was obligated to provide as its share of the cogeneration deal. Houston Lighting & Power is suing Brown & Root for its alleged mismanagement of the South Texas project, and the city of Austin is suing HL&P for misrepresenting B&R's competence as a manager. B&R is suing HL&P in return. Wabash Valley is suing PSI to recover its $466 million investment in Marble Hill *(see box, p. 95)*.

"A lot of these companies could sue some of their big contractors, but they're not going to," one consultant explains. "Termination payments for some of these canceled plants will have to be made, and the utilities would like to defer them, to work out an accommodation."

The China Syndrome is, like the movie that popularized the phrase, just a fiction after all.

One way or another, then, the utilities are likely to come through. Indeed, once the current construction program is at an end, they should recover their traditional earning power, if not necessarily their traditional growth. In the very long run—how's this for irony?—their biggest problem may turn out to be finding an outlet for their rising cash flow (FORBES, *Jan. 28, p. 31*).

But there still will be a price to be paid for the nuclear industry's miscalculations, inefficiencies and mismanagement over the years. When the last nuclear plants go into operation, by one authoritative reckoning, power costs in the U.S. will be 5% higher on average than they might have been otherwise. That's hardly any burden in itself, perhaps, but in many parts of the country the price increases should be powerful enough to reshape the economic patterns of the region, weakening regions where power costs will go sharply higher and strengthening those where they will not. Lilco worries that high-cost nuclear power will drive industry away from Long Island, while Commonwealth Edison is counting on low-cost nuclear power to make northern Illinois increasingly attractive to industry. And there you have it: both the penalty and the promise of the U.S. nuclear program. The penalties will remain. The promise expires with the program itself.

4 Tomorrow

Can the U.S. afford to let the nuclear option die?

Sooner or later—in the mid-Nineties, in the late Eighties even—the U.S. will almost certainly need to begin planning large central power stations again. As the Atomic Industrial Forum points out, assuming a 3% annual growth in electrical demand, the U.S. will need 300,000 megawatts of additional capacity by 2000. Only 100,000 megawatts—implying a 1% annual growth expectation—is currently being planned. Given the long lead times involved in building new capacity, someone must get moving in a timely way. If no one does, as Harvard utility expert Peter Navarro points out, "A shortage of electricity generation could become the binding restraint on GNP growth."

There are ways to temporize, of course, between now and the end of the century even if demand does grow by as much as 3% annually. Since any shortages are likely to be regional, the utilities could strengthen their interconnections with companies and regions with surpluses. Then, too, there's plenty of excess power in Canada. And the utilities could even use their existing capacity more efficiently through various load management schemes. Finally, various small power sources—small dams, geothermal or solar energy—may prove more effective in providing capacity than most utility men expect.

But there's little likelihood of much of this happening, as matters now stand. Protective of their own territories, many utilities are reluctant to wheel power from one interconnection to another, while the U.S. itself may be reluctant to become overdependent on Canadian power supplies, even if the Canadians are willing to sell their surplus at reasonable prices.

So, after the temporizing, what kind of generation will we choose? Hardly anyone believes oil and gas prices will be low enough or supplies abundant and secure enough for oil to be a real possibility. There's coal, of course, but nobody willingly uses coal unless there is no alternative. And conceivably the acid rain problem could one day limit coal usage considerably. But if not coal, and if not oil and gas, then what?

Everywhere else in the world the answer is nuclear. Could it not be so for the U.S. if only its cost, regulatory and management problems could be solved? As Commonwealth Edison's Chairman James O'Connor points out, "American engineering, American equipment, American constructors are building plants all over the world and bringing them in at roughly one-quarter to one-third the cost of plants in the U.S. We can do it technically. We have to learn to do it institutionally, rationalizing the process to eliminate the adversarial system that we have presently. And if we learn how to do it institutionally, I think the nuclear option is very much alive."

The federal—NRC—regulatory problem that has produced open-ended costs, rework and delay may be on the way to solving itself. The torrent of NRC regulations since TMI suggests that the NRC believes the present generation of plants is not really safe. But that may be changing. Recent research into what would happen in an accident involving a reactor core indicates that the radiation hazards are so much less than previously thought that the risk to the public is virtually nil. The China Syndrome is, like the movie that popularized the phrase, just a fiction after all.

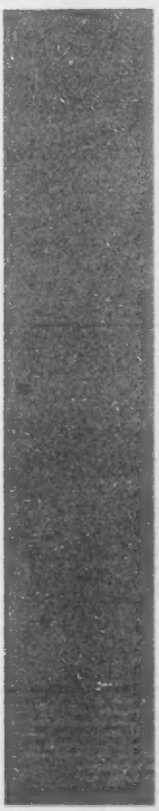
Even without any new assessment of nuclear risk, NRC Chairman Nunzio Palladino recently urged the industry to develop one standardized design, get a site approved and demonstrate just how quickly and cheaply a standard plant can be built. Booz, Allen & Hamilton, the management consultants, have taken up the challenge and

proposed an industry consortium to do just that.

Standardized designs are the industry's great panacea these days. Superficially, at least, the argument seems sound enough. You want a plant design that is 100% complete, one that the NRC could approve once and for all and so end all those delays involving construction permits and operating licenses, rework and quality concerns, at a considerable saving. In nuclear construction, the learning curve really is there. Using a standardized design, Palo Verde 2 was built in 15% less time than Palo Verde 1, for instance, and Palo Verde 3 in 30% less time than 2.

The model everyone cites is the French nuclear program, with its two large-scale standardized designs—in 900- and 1,300-megawatt sizes. The government designs and builds all the plants, regulates them, even controls the prices at which it buys the equipment. The French have the same two-stage regulatory process that the U.S. does, but they permit no public participation in the regulatory process once the project gets under way. (The Canadians go them one better and permit no public participation at all.) That prohibition may be half the battle, but whether such a system could be implemented in a far more open society like the U.S. is problematic.

Can a technology as rigorous, demanding and useful as nuclear power find a place in a society as open as the U.S.?



Conceived as a response to the 1973 oil crisis, the French program has built 30 reactors so far, with 27 more under way. At roughly $1,000 per kw, the newest French reactors cost considerably less than most new U.S. reactors, but they probably run just about neck and neck with Commonwealth Edison's LaSalle 2 plant and Duke Power's McGuire 2 plant, especially when you consider that one-third of McGuire's costs and one-fifth of LaSalle's are capitalized interest, costs that the French reactors do not carry. U.S. nuclear costs would start coming down by at least a third if the utilities could put CWIP into the rate base.

What many advocates of the French program really seem to admire is the government's total control of the industry. At least one NRC commissioner, James Asselstine, thinks the U.S. would have been better off if the government had never lost control of the program. "The earlier reactors were built under a cooperative government-industry program, and the early reactors turned out very well," he notes. "The problem started when we scaled up, and more and more private companies got involved."

Standardization has its own drawbacks, in any case. It tends to discourage innovation, and it freezes design defects as well as solutions. As the French themselves are uncomfortably aware, their nuclear program could one day be in real trouble if they have mistakenly standardized on the current equivalent of TMI or General Electric's troubled Mark II containment structure.

And standardization is not enough in itself to solve all cost problems. Union Electric's Callaway and Kansas Gas & Electric's Wolf Creek are twins, but for all that, both are fairly high-cost twins. Indiana Public Services' Marble Hill and Commonwealth Edison's Byron were twinned plants as well, but what made Byron a success and Marble Hill a failure was not the standardized design but the managerial talents of the companies that undertook them. Management talent, or the lack of it, is what has made most of the difference in virtually every other nuclear project as well. It would be unfortunate if the technocrats forgot the central lesson of the nuclear follies.

A return to the turnkey designs of the Sixties might offer a solution to both the standardization and management problems, but no one seems to have the stomach for that right now. Properly handled, however, standardization should help reduce plant costs. Scaling down—from 1.2 million kw to 600,000, say—apparently isn't likely to help much. Nuclear power needs economies of scale to compete with coal. At a time when the growth in demand has slowed, this means that even large utilities may have to pool their resources in joint ventures, regional companies and generating companies, in order to balance capacity with consumption.

But none of these promising tactics will be easy to effect without some hard bargaining having gone before. State regulatory commissions should be able to justify the inclusion of CWIP in the rate base—after all, those are costs of an ongoing business, and consumers could reasonably be expected to finance them. But the commissions will almost certainly want something in return. "That means that management's going to have to give up some of their prerogatives," says Milbank Tweed's Jay Worenklein, "and utility companies aren't eager to have utility commissions looking over their shoulders every step of the way."

Look at the trouble Philadelphia Electric has been having. For several years now the Pennsylvania PUC has been trying to force PE to postpone Limerick 2 for lack both of a market and of adequate financial resources. PE finally suspended construction last January after the PUC refused to approve an issue of $1.1 billion in bonds, but it continues to push for completion. An exasperated PUC finally ordered it to show cause why the unit should be completed. That's the kind of interference most utilities figure they don't need.

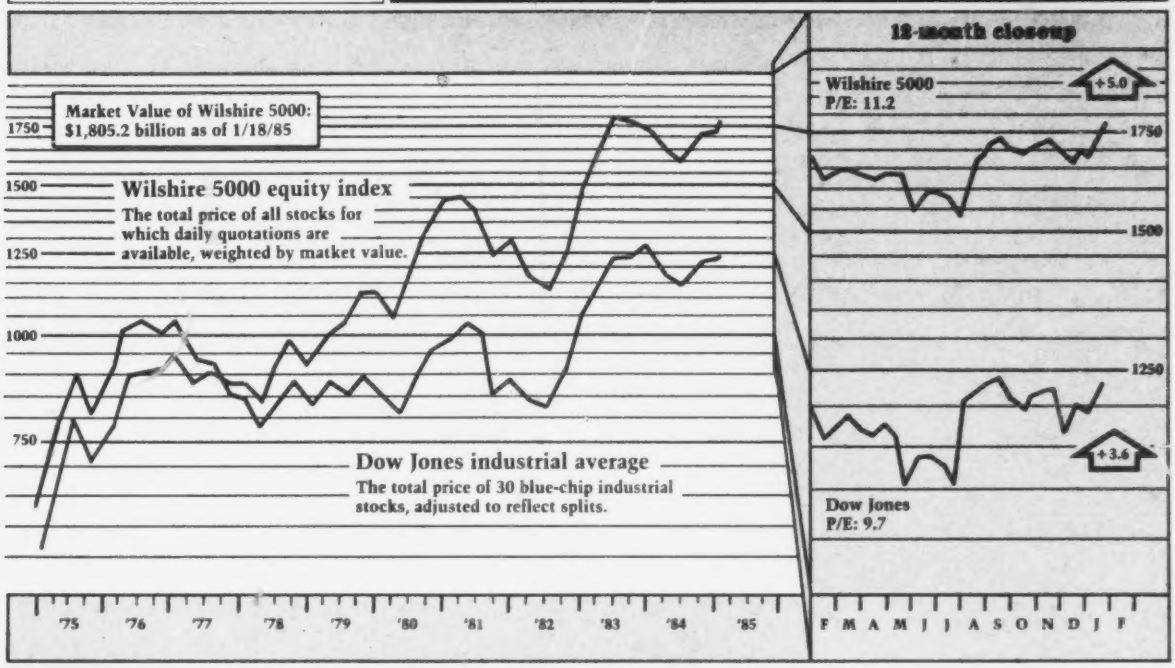
As for joint ventures, even assuming they aren't in effect ruled out by the Federal Energy Regulatory Commission (FORBES, *Dec. 31, 1984, p. 70*), state regulatory agencies aren't likely to take kindly to the emergence of local generating companies to produce power for local consumption that would be regulated by the FERC. That was why the New York PSC refused to approve Empire State Power Resources, a proposed utility-owned generating company that would have taken over Shoreham. "The PSC turned it down," Jay Worenklein says, "on the basis that they would not tolerate the transfer to federal regulation of the rates relating to those plants." In short, the federalization or regionalization of regulation would stir up states' rights sensibilities.

Such are the possibilities and the problems. The means of reviving the nuclear option are available, but they cannot be implemented without sacrificing consumer interests to those of the community at large, corporate interests to those of the states, state interests to those of the federal government. Is the U.S. really so inflexible?

In the end the problem may boil down simply to this: Can a technology as rigorous and demanding and, for all that, as useful as nuclear power find a place in a society as open as the U.S.'? ■

Edited by Steve Kichen

The Forbes/Wilshire 5000 Review



A rally running on all cylinders. Since the start of the new year Wall Street has been on an upward ride. While secondary issues held on to the lead position that they grabbed early in this rally, significant gains were registered by all major indicators. During the last two weeks the Wilshire index of more than 5,600 stocks rose 5%. The NYSE composite posted a 4.7% gain, the Amex a 4.4% gain and the NASDAQ a 6.8% advance. Although blue-chip issues were generally not as strong, the 30-stock Dow industrials still managed a 3.6% rise over the two-week stretch. For the four-week period NASDAQ issues show the best performance, a 7.7% gain, while the Dow industrials again bring up the rear, with only a 2.4% advance.

Right at the beginning of the year our investor yardsticks underwent a sharp reversal in trend. For most of 1984 the yardsticks had been showing distinctly better performances among the lower-risk, conservative issues. Now the speculative issues are outperforming their more conservative counterparts by a wide margin. During the last four weeks, for example, high-volatility issues bested low-volatility issues by better than a 2.5-to-1 ratio. In much the same way shares of small companies outperformed those of large companies and high-P/E shares gained more than low-P/E shares.

Close-up On The Equity Markets

Performance of six leading indexes

Percent change	Wilshire 5000	Forbes 500[1]	Dow Jones industrials	NYSE Composite	Amex Market Value Index	NASDAQ Composite
in last 4 weeks	4.1	2.9	2.4	3.6	4.8	7.7
in last 52 weeks	1.1	3.6	–2.5	3.0	–6.9	–7.5

Stock performance based on six key investor yardsticks

Percent change	Company size		Volatility[2]		P/E multiple		Dividend yield		Growth profile[3]		Share price	
	large	small	high	low	over 25	under 5	over 7.5%	none	high	low	over $40	under $4
in last 4 weeks	4.3	9.4	12.0	4.6	9.9	5.1	4.0	11.4	11.1	4.8	3.7	10.7
in last 52 weeks	3.1	–7.8	–11.6	14.1	–15.7	5.8	11.0	–8.5	–10.8	12.4	6.7	–17.0

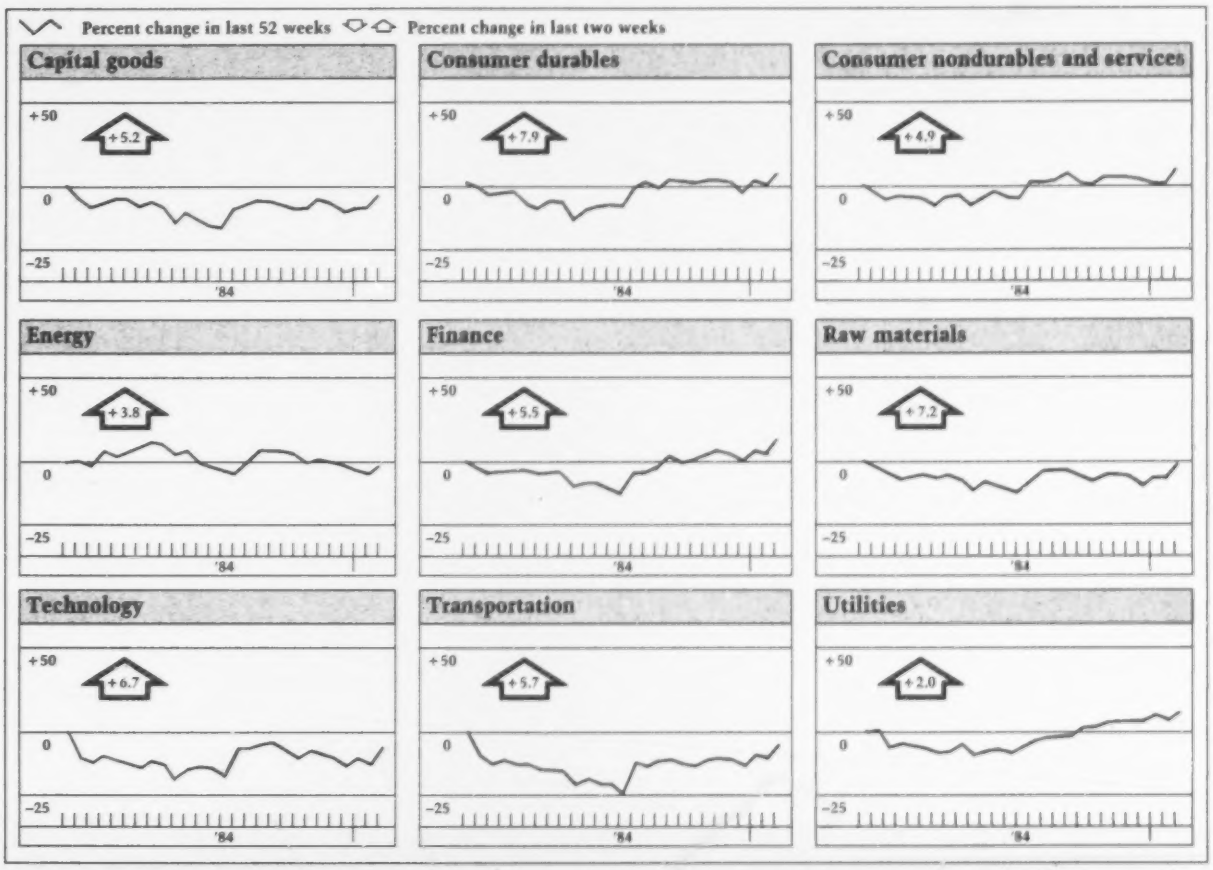
[1]Based on sales.
[2]A stock's sensitivity to overall market movement. High-volatility issues have wide price fluctuations, low-volatility issues are more table.
[3]A quantitative evaluation of a stock's growth image, determined by Wilshire Associates.

Note: All data for periods ending 1/18/85. Prepared by Wilshire Associates, Santa Monica, Calif.

Kenneth Alcorn

Where The Action Is

What bad news? During the most recent two weeks all nine Wilshire sectors moved ahead, with six of the groups outperforming the market. Even transportation stocks outpointed the Wilshire index, despite sharp declines in several airline stocks following a new fare war started by AMR's American Airlines. The word from Detroit was that there would not be a drastic jump in fourth-quarter 1984 earnings. Nevertheless, consumer durables took first position with a 7.9% gain. One of three groups that underperformed the Wilshire was energy stocks, with a 3.8% increase. But the oils registered this healthy advance even though crude and refined petroleum prices continued to fall. Meanwhile, utilities, up 2%, registered the smallest gain. But these shares typically lag in strong up markets.



What The Analysts Think

Last-minute bets. Just before the release of hundreds of 1984 annual earnings reports, security analysts scurried in with last-minute changes in their earnings estimates. During the last two weeks the experts lowered their forecasts for all sectors. Utility shares show the smallest change, transportation shares the largest.

Forecasting the Forbes 500

Performance period	Average earnings per share	P/E
latest 12 months	$3.79	9.6
1984 estimates	3.92	9.3
1985 estimates	4.56	8.0

Rank based on change in estimate	Sector	Estimated 1984 EPS	Estimated 1984 P/E	% change in 1984 estimate in 2 weeks	% change in 1984 estimate in 4 weeks
1	Utilities	$3.32	7.3	-0.07%	-0.14%
2	Consumer durables	4.67	7.8	-0.20	-0.43
3	Capital Goods	2.55	11.9	-0.34	-0.34
4	Energy	3.72	7.9	-0.35	-3.04
5	Finance	2.79	9.9	-0.41	-1.94
6	Consumer nondurables	2.40	11.3	-0.89	-1.53
7	Technology	2.72	11.5	-0.91	-1.37
8	Raw materials	2.22	10.5	-1.05	-2.20
9	Transportation	2.56	9.3	-1.33	-1.18

Earnings projections are equal-weighted consensus estimates from over 2,000 security analysts. Data are compiled and updated continously by the Institutional Brokers Estimate System (IBES), a service of Lynch, Jones & Ryan, a New York-based brokerage firm.

Note: All data for periods ending 1/18/85. Prepared by Wilshire Associates, Santa Monica, Calif., IBES, a service of Lynch, Jones & Ryan, New York.

The Forbes/TUCS Institutional Portfolio Report

Institutions—pension funds, mostly—carry a lot of weight on Wall Street. When they throw that weight around, stocks and bonds can move abruptly. The wary individual trader keeps an eye on these heavyweights. What stocks are institutional favorites? Are the big players moving in or out of technology stocks? Utilities? Consumer issues? Are money managers deserting equities on balance for cash or bonds or real estate?

The figures shown on these two pages answer such questions. They are based on more than 3,000 pension funds monitored by Wilshire Associates in Santa Monica, Calif. in its Trust Universe Comparison Service (TUCS). Within this pension sample are accounts holding $136 billion in equities—that is almost 8% of publicly held stock—dispersed among 4,126 issues.

How have the institutions been doing? Not poorly, of late. For the last quarter of 1984 the median total return (appreciation, interest and dividends) for the TUCS sample was 3%. That beats both the total return on stocks (1.3% for the Wilshire 5000) and what an account could have earned in a risk-free cash investment.

There is an element of self-fulfillment in the money managers' performance. "The institutions jumped all over some of the better [performing] stocks, like Digital Equipment," says Dale Stevens, a vice president of Wilshire. Meanwhile, heavy institutional buying of Digital helped that stock. As noted in the "Top ten holdings" table below, Digital is an institutional favorite. And as shown in the table "Position changes" below at right, Digital's share of the average account has increased. The gain of 0.2 percentage points looks small but represents hundreds of millions of dollars in the institutional equity pool.

The table "Where the institutions put their money" shows that institutions ended the quarter with a greater allocation of their portfolios to equities. To some extent, this reflects the fact that stocks favored by institutions did fairly well. In the third table on the right, the "shift in holdings" column, by contrast, shows net changes in asset allocation above and beyond stock price changes.

Where the institutions put their money

Segment	Portfolio weighting—most recent quarter	Portfolio weighting—previous quarter
Equity	57.8%	50.5%
Fixed income	27.5	31.5
Cash and equivalents	10.9	12.6
Convertibles	0.9	0.9
Other[1]	2.8	4.5

Equity portfolio characteristics

Financial ratio	Institutional portfolios	Wilshire 5000
Price/earnings ratio	11.2	11.2
Dividend yield	3.8%	4.3%
Beta[2]	1.01	1.10

The most recent quarter

Segment	Median total return	Shift in institutional holdings
Equity	1.7%	–4.2%
Fixed income	7.5	–3.6
Cash and equivalents	2.5	–14.5
Convertibles	4.6	2.4
Other[1]	0.2	NA
Total	3.0	–5.1

Top ten holdings

Security	Weighting of institutional portfolios	Total quarter return
IBM	4.1%	0.0%
General Motors	1.4	4.7
General Electric	1.2	2.6
Philip Morris	1.0	4.5
Digital Equipment	0.8	17.7
Exxon	0.8	2.5
Schlumberger	0.7	–16.5
Ford Motor	0.7	1.7
Atlantic Richfield	0.7	–13.8
American Express	0.7	11.0

Position changes: These securities had the greatest changes in institutional holdings over the last quarter.

Company	Increase in holdings	Company	Decrease in holdings
Chevron	0.4%	IBM	–0.3%
Xerox	0.3	Atlantic Richfield	–0.3
Digital Equipment	0.2	Motorola	–0.2
Philip Morris	0.2	Ford Motor	–0.2
Safeway Stores	0.2	Coca-Cola	–0.2
Waste Management	0.1	Schlumberger	–0.2
FW Woolworth	0.1	Hewlett-Packard	–0.2
AMR	0.1	Texas O&G	–0.2
NWA	0.1	Wal-Mart Stores	–0.1
Loews	0.1	American Broadcasting	–0.1

[1]Real estate, foreign investments, venture capital, guaranteed insurance contracts.
[2]A measure of risk. A stock with a beta of 1.00 tends to move up or down at the same rate as the S&P's 500. NA: Not available

Note: Data for quarter ending 12/31/84. Prepared by the Trust Universe Comparison Service (TUCS®), a service of Wilshire Associates, Santa Monica, Calif.

Edited by Steve Kichen

Where the institutions are—and aren't

Most overweighted relative to Wilshire 5000:	% of institutional universe	% of Wilshire 5000	Most underweighted relative to Wilshire 5000:	% of institutional universe	% of Wilshire 5000
Digital Equipment	0.8%	0.4%	Exxon	0.8%	2.1%
Philip Morris	1.0	0.6	Shell Oil	0.0	1.0
Federated Dept Stores	0.5	0.1	AT&T	0.5	1.2
Citicorp	0.6	0.3	El du Pont de Nemours	0.3	0.7
Lockheed	0.4	0.2	Standard Oil Ohio	0.3	0.6
Waste Management	0.4	0.1	Royal Dutch Petroleum	0.5	0.8
McDonald's	0.5	0.3	General Electric	1.2	1.5
Boeing	0.5	0.3	IBM	4.1	4.4
AMR	0.3	0.1	Standard Oil Indiana	0.6	0.8
American Express	0.7	0.5	BellSouth	0.3	0.6

The exodus from energy. Oil is not popular among institutional investors these days. At the end of the third quarter of 1984, 9.4% of the typical institutional equity portfolio was invested in energy. For the most recent quarter that figure was 8.9%. Exxon is the most widely held energy stock, representing 0.8% of institutional portfolios. But note in the table above that Exxon and four other oils appear on the list of issues underweighted by institutions, meaning that these stocks make up a smaller percentage of institutional portfolios than they do of the market.

In contrast, the list of overweighted securities reflects the desire of pension money managers to have relatively high levels of growth, but with some size and financial stability. McDonald's, for example, fits that description. However, the recent sudden drop in the price of Toys "R" Us illustrates the danger a small investor faces when an institutional favorite falls from grace. The table below shows sector weightings for institutional stock portfolios, with some of the more important stocks within each sector listed as well.

Sector activity and top holdings

% of institutional portfolio: ■ most recent quarter ■ previous quarter

Consumer nondurables	25.0	25.2	Raw materials	10.3	11.3	Energy	8.9	9.4
	% holdings			% holdings			% holdings	
Philip Morris	1.0%		Waste Management	0.4%		Exxon	0.8%	
Eastman Kodak	0.5		El du Pont de Nemours	0.3		Schlumberger	0.7	
Pfizer	0.5		Dow Chemical	0.3		Atlantic Richfield	0.7	
Federated Dept Stores	0.5		Aluminum Co of Am	0.3		Standard Oil Indiana	0.6	
McDonald's	0.5		Allied Corp	0.2		Mobil	0.5	
Consumer durables	4.8	5.1	Capital goods	5.0	5.5	Technology	16.3	17.5
	% holdings			% holdings			% holdings	
General Motors	1.4%		General Electric	1.2%		IBM	4.1%	
Ford	0.7		Emerson Electric	0.3		Digital Equipment	0.8	
Chrysler	0.3		Westinghouse Electric	0.2		Boeing	0.5	
Goodyear Tire & Rubber	0.3		Caterpillar Tractor	0.2		Minnesota Mining & Mfg	0.5	
Whirlpool	0.2		Signal Cos	0.2		Hewlett-Packard	0.5	
Transportation	3.4	3.5	Utilities	8.2	7.3	Finance	10.4	10.3
	% holdings			% holdings			% holdings	
AMR	0.3%		AT&T	0.5%		American Express	0.7%	
Norfolk Southern	0.3		NYNEX	0.4		Citicorp	0.6	
Burlington Northern	0.3		GTE	0.4		Phibro-Salomon	0.4	
Union Pacific	0.2		Southwestern Bell	0.4		American Intl Group	0.4	
UAL	0.2		US West	0.4		Merrill Lynch	0.3	

Plant[1]	Utility	Ownership	Architect/ engineer	Construction manager	Reactor supplier	Total expected cost (billions)	Net capacity (megawatts)	Cost per kw	AFUDC as % of cost	Year ordered	Year of expected service	Gross rate impact[2]
Shoreham[a]	Long Island Lighting Co	100%	Stone & Webster	Utility	General Electric	$4.2	809	$5,192	35%	1967	1985	33%
Midland 2	Consumers Power Co	100	Bechtel	Bechtel	Babcock & Wilcox	4.0	808	4,889	30	1968	Canceled	47
Nine Mile Point 2	Niagara Mohawk Power Co	41	Stone & Webster	Stone & Webster	General Electric	5.1	1,084	4,705	34	1971	1986	19
	NY State Electric & Gas Corp	18										20
	Long Island Lighting Co	18										12
	Rochester Gas & Electric Co	14										28
	Central Hudson Gas & Electric	9										10
Beaver Valley 2	Duquesne Light Co	14	Stone & Webster	Utility	Westinghouse	3.5	833	4,166	33	1971	1986	11
	Ohio Edison	42										17
	Cleveland Electric Illuminating	24										13
	Toledo Edison	20										25
Seabrook 1	Public Service of New Hampshire	36	United Engineers & Constructors	New Hampshire Yankee	Westinghouse	4.5	1,150	3,913	36	1972	1986	68
	United Illuminating	18										32
	Massachusetts Municipal Wholesale	12										—
	New England Power Co	10										6
	Central Maine Co	6										11
	Connecticut Light & Power	4										2
	Others	14										—
Zimmer 1	Cincinnati Gas & Electric	40	Sargent & Lundy	Henry J Kaiser Co	General Electric	3.1	810	3,827	35	1969	Canceled	27
	Columbus & Southern Ohio Electric Co	29										4
	Dayton Power & Light	31										25
River Bend 1	Gulf States Utilities Co	70	Stone & Webster	Stone & Webster	General Electric	3.6	940	3,805	24*	1972	1985	28
	Cajun Electric Power Coop	30										—
Limerick 1[a]	Philadelphia Electric Co	100	Bechtel	Bechtel	General Electric	3.8	1,055	3,602	31	1969	1985	33
Hope Creek 1	Public Service Electric & Gas	95	Bechtel	Bechtel	General Electric	3.8	1,067	3,561	24	1969	1986	25
	Atlantic City Electric Co	5										7
Harris 1	Carolina Power & Light	84	Ebasco	Daniel Intl	Westinghouse	3.0	900	3,333	26	1971	1986	28
	North Carolina Eastern Municipal Power Agency	16										—
Milistone 3	Northeast Utilities	65	Stone & Webster	Stone & Webster	Westinghouse	3.8	1,150	3,326	31	1973	1986	27
	New England Power Co	12										6
	Montaup Electric Co	4										11
	United Illuminating Co	4										6
	Public Service of New Hampshire	3										6
	Central Maine Power	2										3
	Others	10										—
Clinton 1	Illinois Power Co	82	Sargent & Lundy	Baldwin Associates	General Electric	3.1	950	3,305	25*	1973	1986	58
	Soyland Power Coop	10										—
	Western Illinois Power Coop	8										—
Vogtle 1, 2	Georgia Power Co	46	Southern Services/ Bechtel	Utility	Westinghouse	7.2	2,200	3,273	34*	1971	1987, '88	11
	Oglethorpe Power Corp	30										—
	Municipal Electric Authority of Georgia	23										—
	City of Dalton	1										—
Perry 1	Cleveland Electric Illuminating Co	31	Gilbert	Utility	General Electric	3.9	1,205	3,270	30	1972	1985	18
	Ohio Edison Co	30										14
	Toledo Edison	20										28
	Duquesne Light Co	14										12
	Pennsylvania Power	5										3
Marble Hill 1, 2	Public Service of Indiana	83	Sargent & Lundy	Utility	Westinghouse	7.0	2,260	3,097	50	1974	Canceled	120
	Wabash Valley Power Assn	17										—
Fermi 2	Detroit Edison Co	83	Utility	Daniel Intl	General Electric	3.4	1,100	3,068	31*	1968	1985	22
	Wolverine Power Supply Coop	17										—
Washington Nuclear 2[c]	Washington Public Power Supply System	100	Burns & Roe	Bechtel	General Electric	3.4	1,100	3,045	—	1971	1984	—
South Texas 1, 2	Houston Lighting & Power Co	31	Bechtel	Ebasco	Westinghouse	7.5	2,500	3,000	27	1973	1987, '89	12
	City Public Service of San Antonio	28										—
	Central Power & Light Co	25										13
	City of Austin	16										—
Grand Gulf 1[b]	Middle South Utilities	90	Bechtel	Bechtel	General Electric	3.4	1,250	2,724	46*	1972	1985	20
	South Mississippi Electric Power	10										—
Callaway 1[b]	Union Electric	100	Bechtel	Daniel Intl	Westinghouse	3.0	1,150	2,609	37	1973	1985	42
Wolf Creek	Kansas Gas & Electric Co	47	Bechtel/ Sargent & Lundy	Daniel Intl	Westinghouse	2.9	1,150	2,522	32	1973	1985	62
	Kansas City Power & Light Co	47										44
	Kansas Electric Power Coop	6										—
Waterford 3[a]	Louisiana Power & Light Co	100	Ebasco	Ebasco	Combustion Engineering	2.7	1,104	2,473	21	1970	1985	18
Diablo Canyon 1[b], **2**	Pacific Gas & Electric	100	Utility	Utility	Westinghouse	5.4	2,190	2,466	34	1966, '68	1985, '85	25
Palo Verde 1[a], **2, 3**	Arizona Public Service	29	Bechtel	Bechtel	Combustion Engineering	9.3	3,810	2,441	37	1973	1985, '86, '87	56
	El Paso Electric Co	16										89
	Southern California Edison	16										6
	Public Service of New Mexico	10										42
	Salt River Project	23										—
	SCA Public Power Authority	6										—
Bellefonte 1, 2	Tennessee Valley Authority	100	Utility	Utility	Babcock & Wilcox	5.7	2,664	2,134	40	1970	1989, '91	—
Susquehanna 2[b]	Pennsylvania Power & Light Co	90	Bechtel	Bechtel	General Electric	2.2	1,050	2,095	31	1968	1985	29
	Allegheny Electric Coop	10										—
San Onofre 3[c]	Southern California Edison	75	Bechtel	Utility	Combustion Engineering	2.3	1,100	2,045	40*	1970	1984	7
	San Diego Gas & Electric Co	20										7
	City of Anaheim	3										—
	City of Riverside	2										—
Byron 1[a], **2**	Commonwealth Edison	100	Sargent & Lundy	Utility	Westinghouse	4.2	2,240	1,866	39	1971	1985, '86	16
Braidwood 1, 2	Commonwealth Edison	100	Sargent & Lundy	Utility	Westinghouse	4.1	2,240	1,835	43	1972	1986, '87	16
Catawba 1[a]	Duke Power	25	Utility	Utility	Westinghouse	3.9	2,290	1,703	35	1972	1985	7
	North Carolina Electric Membership Corp	56										—
	Saluda River Electric Coop	19										—
Catawba 2	No Carolina Municipal Power Agency #1	75									1986	—
	Piedmont Municipal Power Agency	25										—
Comanche Peak 1, 2	Texas Utilities Electric Co	88	Gibbs & Hill	Brown & Root	Westinghouse	3.9	2,300	1,696	24	1972	1985, '86	18
	Texas Municipal Power Authority	6										—
	Brazos Electric Power Coop	4										—
	Tex-La Electric Coop of Texas	2										—
Watts Bar 1, 2	Tennessee Valley Authority	100	Utility	Utility	Westinghouse	3.9	2,354	1,672	33	1970	1985, '87	—
Summer 1[c]	South Carolina Electric & Gas	67	Gilbert	Daniel Intl	Westinghouse	1.3	900	1,446	24	1971	1984	25
	South Carolina Public Service	33										—
LaSalle 2[b]	Commonwealth Edison	100	Sargent & Lundy	Utility	General Electric	1.1	1,078	1,020	22	1970	1984	4
McGuire 2[c]	Duke Power	100	Utility	Utility	Westinghouse	1.1	1,180	932	33	1969	1984	8